User's Manual

2755

Portable Wheatstone Bridge

With Murray and Varley Loop Tester

YOKOGAWA
Yokogawa Meters & Instruments Corporation

IM 2755-97E
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Cautionary Notes for Safe Use of the Product

■ The following symbol is indicated on the instrument to ensure safe use.

"Handle with care!" This symbol is indicated where the operator must refer to instructions in the manual or attached material in order to protect personnel and the instrument.

■ Since mishandling the instrument can result in an accident that may lead to injury or death of the operator, such as an electric shock, be sure to observe the following instructions.

⚠ WARNING

● Protective Measures
- If a crack appears in the instrument after it has been accidentally dropped or bumped, the safety-purpose insulation may be damaged. By all means do not use the instrument, but ask the manufacturer for repair.

● Connection
- To avoid electric shock, be sure to apply protective grounding to the grounding terminal.

● Measurement
- Always maintain the instrument within the limits for allowable current, voltage and power, during operation. If there is more than one limit for any of these parameters, the lowest limit takes precedence.

● External Power Supply
- Only operate the instrument on a supply voltage no greater than 70 V DC.

● Operating Environment
- Do not operate the instrument in a flammable or explosive gas atmosphere.
- Do not operate the instrument if there is any condensation on it.

● Disassembly
- Nobody except members of the manufacturer's service staff is allowed to disassemble the instrument.

■ Since mishandling the instrument can result in an accident, such as an electric shock, that may injure the operator or damage the instrument, be sure to observe the following instructions.

⚠ CAUTION

● Batteries
- Do not use a mixture of different types of batteries or a mixture of old and new batteries. If the instrument will not be used for a prolonged period, remove the batteries before storage. The battery fluid will leak more readily during long-term storage, resulting in an instrument malfunction.

● Plastic Case
- The panel and case of this instrument are made of ABS resin. Special caution must be taken to protect them from heat and organic solvent such as lacquer thinner.

Notice regarding This User's Manual

1. The information covered in this user's manual is subject to change without prior notice.
2. Every effort has been made to ensure accuracy in the preparation of this manual. Should any errors or omissions come to your attention however, please inform Yokogawa Corporation accordingly.
3. Yokogawa Corporation is by no means liable for any damage resulting from the user's mishandling of the product.

Precautions for Use

⚠ WARNING

● External Power Supply
When external power supply is employed to increase sensitivity, full caution must be taken to avoid excess current flow, since all wire-wound bridge elements used in this instrument can endure up to 1 watt max. Before higher voltage is applied, take rough balance of bridge with low voltage. Caution must be taken not to set × 1000 dial to "0" and not to short-circuit Rx terminals.

⚠ CAUTION

● Operation of Button Switch
• BA and GA button switches should be at OFF position after measurement.
• During measurement, BA button switch must be pressed prior to GA button switch. If this order is inverted, the movement of the galvanometer will be kicked when BA button switch is pushed due to inverse emf of inductance of the object under test, and the direction of measuring dial adjustment shall be thereby misled.
● Lead Resistance
In measurement of resistances below 10 ohms, the lead wire resistance should not be neglected. The lead resistance compensation must be made by measuring the lead resistance separately.

CONTENTS

1. GENERAL

The 2755 Portable Wheatstone Bridge is quite convenient with general resistance measurement and fault point detection of lines by Murray and Varley loop testing methods.

2. SPECIFICATIONS

Measuring Range: 1Ω to 10MΩ (4 digits)

Measuring arm: 1Ω×10+10Ω×10+ 100Ω×10 + 1000Ω×10 (4 dials)

Ratio arm: ×0.001, ×0.01, ×0.1, ×1, ×10, ×100, ×1000 and for Murray loop test M10, M100, M1000

Accuracy

Overall

100Ω to 100kΩ:	±0.1% of reading
10Ω to 1MΩ:	±0.3% of reading
1Ω to 10MΩ:	±0.6% of reading

Measuring arm

×1000:	±0.06%
×100:	±0.1%
×10:	±0.5%
×1:	±3% (Including residual resistance)

Multiply dial (Ratio)

×0.1, ×1, ×10:	±0.07%
×100, ×0.01:	±0.2%
×1000, ×0.001:	±0.5%
M10, M100, M1000:	±0.1%

Temperature Coefficient of Resistance Elements

less than ±5×10^{-5}/°C (5 to 35°C)

±2×10^{-5}/°C (20 to 35°C)

Galvanometer

Sensitivity:	0.9μA/div. (±20%)
Internal resistance:	150Ω (±20%)
Period:	Within 2.6 seconds

Operating Temperature: 5 to 35°C

Operating Humidity: 85% R.H. or less

Power Source: Three 1.5V batteries (built-in) type SUM-1

Dimentions: Approx. 182×226×128mm

Weight : Approx. 2kg (4.4lbs)

Accessory

User's manual: 1 copy.

Carrying case (B9350AW): 1pc.

Optional Accessory

Carrying case: B9350AW (275600)

(Note)

* For the measurement of more than 100kΩ, it is recommended to use external galvanometer, which has high sensitivity.

For example, the 2707 Electronic Galvanometer (Portable type 10μV/div. sensitivity) is suitable for above requirement. It is possible to measure 0.1% variation of Rx value of 2MΩ (4.5V power supply).

3. CONSTRUCTION

3.1 Front Panel

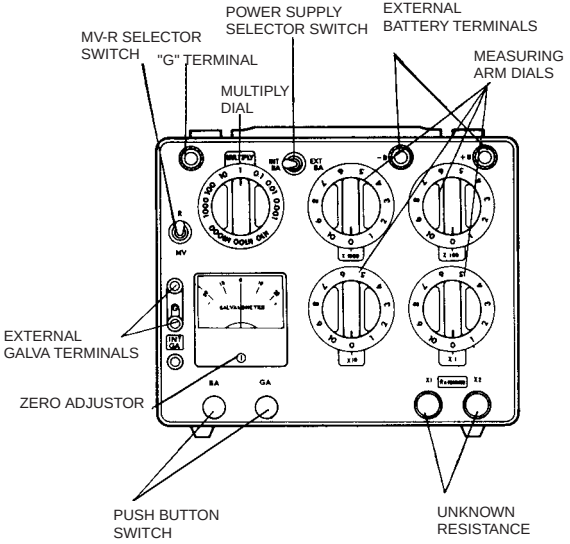

Fig 3.1 Panel

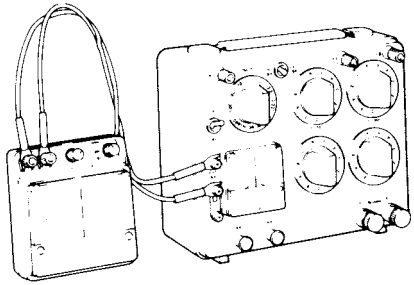

Fig 3.2 Connection of External Galvanometer

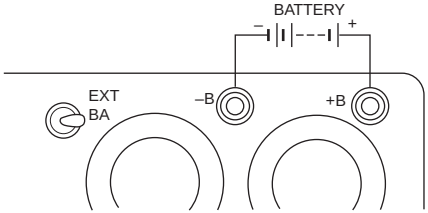

Fig 3.3 Connection of External Battery

3.2 External Galvanometer

When a high sensitive galvanometer is required, move short circuitting bar and short "INT.GA." terminals.

After that, connect the galvanometer to "EXT. GA." terminals are shown in Fig. 3.2.

3.3 External Power Supply

When external power supply is necessary, connect the power supply to –B and +B terminals and turn the power supply selector switch to "EXT BA".

Minimum circuit resistance between –B and +B terminals is approximate 1010 ohms.

Maximum external power supply voltage is 70V DC and maximum current is 60mA DC (Continuous).

1 KΩ (2W type) protective resistance is inserted between the external power supply and bridges, so when the ×1000 dial is set to 0, the circuit is protected from overcurrent.

3.4 Cell Replacement

Remove the cell cover on the bottom of the case, by pulling leg of the cover while pushing the clamping plate towards the arrowed direction to the end. To restore the cell cover, push the clamping plate towards the arrowed direction, insert the hollowed part of the cover under the clamping plate and press the cover down.

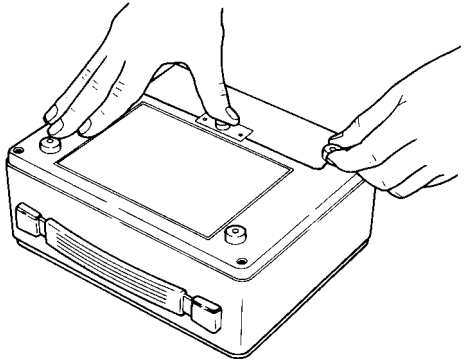

Fig 3.4 Removal of Cell Cover

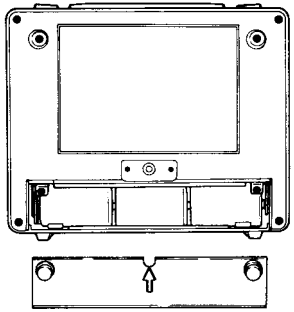

Fig 3.5 Bottom View

4. OPERATION

4.1 Preparation

(1) Confirm that EXT. GA terminals are perfectly short-circuited with short circuiting bar.

(2) Confirm that the galvanometer indicates "0" by opening Rx terminals without pushing GA and BA button switch.

If the galvanometer does not indicate "0", adjust the zero point by turning the zero adjustor. Depress BA push button switch.

(3) GA button switch should be at OFF position.

4.2 Resistance Measurement

(1) Apply unknown resistor to Rx terminals.

(2) Turn the selector switch to "R"

(3) Set the MULTIPLY dial to proper range according to Table 4.1.

(4) Set the Measuring dial at 1999 and push BA push button switch. Then push GA push button switch for a moment to check to which direction, +or –, the galvanometer deflects.

(5) When the pointer deflects + side, increase measuring dials, and when the pointer deflects –(minus) side, decrease measuring dials.
Adjust measuring dials until the galvanometer indicates "0".
Then, the unknown resistance value is measured by the following equation.

Rx	MULTIPLY
less than 10Ω	0.001
10Ω to 100Ω	0.01
100Ω to 1kΩ	0.1
1kΩ to 10kΩ	1
10kΩ to 100kΩ	10
100kΩ to 1 MΩ	100
1MΩ to 10MΩ	1000

Table 4.1 MULTIPLY Dial Setting

Rx=(MULTIPLY factor) ×
(Total value of MEASURING DIALS) [ohms]

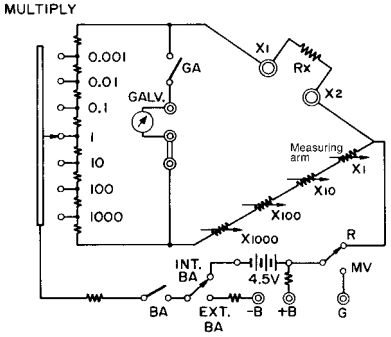

Fig 4.1 Resistance Measurement

4.3 To find out approximate value of Rx

When the resistance value to be measured is entirely unknown and if there is no suitable circuit tester (ohm meter) available, the following procedure shall be effected to find out approximate value of the unknown resistance.

Set MULTIPLY dial to "1" and measuring arm dials to 1000. Pressing the BA button switch, then lightly pressing GA button switch to check to which direction the galvanometer deflects. When the pointer deflects to + side, Rx is higher than 1000 ohms. Then increase MULTIPLY dial to "10" and press BA and GA button switches again. If the galvanometer still deflects to +side, turn MULTIPLY dial to "100".

Suppose that the pointer deflects to –(minus) side by this adjustment, Rx is in the range between 10 kilo-ohms and 100 kilo-ohms. On the other hand, when the galvanometer deflects to –(minus) side by the first settings, Rx is lower than 1000 ohms. In this case, decrease MULTIPLY dial to "0.1" or "0.01" so as to make the pointer deflect to +side.

Approximate value of Rx can be obtained by the above process.

4.4 Interpolation

There might exist a case where perfect balance of galvanometer can not be taken even by adjustment to minimum figure (×1 dial). Read, in such a case, the amount of unbalance from the scale of the galvanometer and estimate fractional parts of the lowest dial by proportional galvanometer deflections.

4.5 Murray Loop Test

Simplified circuit diagram of Murray loop test is illustrated in Fig. 4.2.

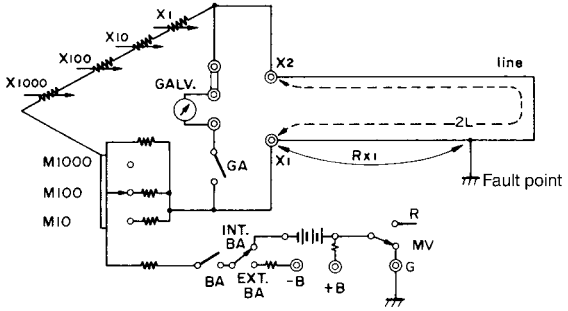

Table 4.2 Murray Loop Test

(1) Connect the looped line under test to Rx terminals. Connect "G" terminal to the earth.

(2) Turn the selector switch to "MV".

(3) Set MULTIPLY dial between M10, M100 and M1000.

(4) Press the "BA" button switch and "GA" button switch. Adjust measuring arm dials until the galvanometer indicates "0".

(5) Obtain the value refering to the following equation:

$$R_{x1}=2L\cdot\frac{\text{(MULTIPLY factor)}}{\text{(MULTIPLY factor)}+\text{(Total value of MEASURING DIALS) ohms}}$$

R_{x1}: Resistance between ×1 terminal and the fault point.

2L: Total resistance of looped line under test.

4.6 Varley Loop Test

Simplified circuit diagram of Varley loop test is illustrated in Fig. 4.3.

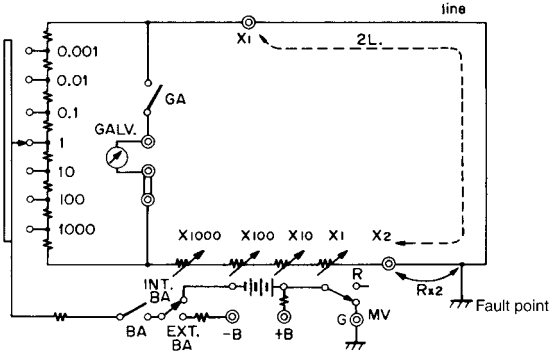

Table 4.3 Varley Loop Test

(1) Connect the looped line under test to Rx terminals. Connect the "G" terminal to the earth.

(2) Turn the selector switch to "MV".

(3) Set the MULTIPLY dial to proper range of 0.001 to 1000.

(4) Press the "BA" button switch and "GA" button switch. Adjust measuring arm dials until the galvanometer indicates "0".

(5) Obtain the value refering to the following equation:

$$R_{X2} = \frac{2L - (\text{MULTIPLY factor}) \times (\text{Total value of MEASURING DIALS})}{1 + (\text{MULTIPLY factor})} \text{ ohms}$$

R_{X2}: Resistance between X_2 terminal and the fault point.

2L: Total resistance of looped line under test.

5. PRINCIPLES OF OPERATION

Fig.5.1 is the theoretical diagram of Wheatstone bridge. When the current at the galvanometer is set to zero by adjusting Rs, the following equation will be established.

$$I_X \cdot R_A = I_S \cdot R_B$$

$$I_X \cdot R_X = I_S \cdot R_S$$

$$\frac{I_S}{I_X} = \frac{R_X}{R_S} = \frac{R_A}{R_B}$$

$$R_X = \frac{R_A}{R_B} R_S$$

As this 2755 Portable Wheatstone Bridge is so designed that R_A/R_B can be set within the range of 0.001 to 1000 by MULTIPLY dial, the unknown resistance value Rx can be obtained by multiplying the Rs value by the multiplying factor.

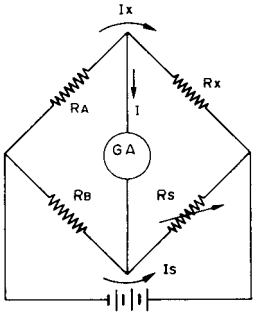

Fig.5.1 Theoretical Circuit Diagram

6. MAINTENANCE

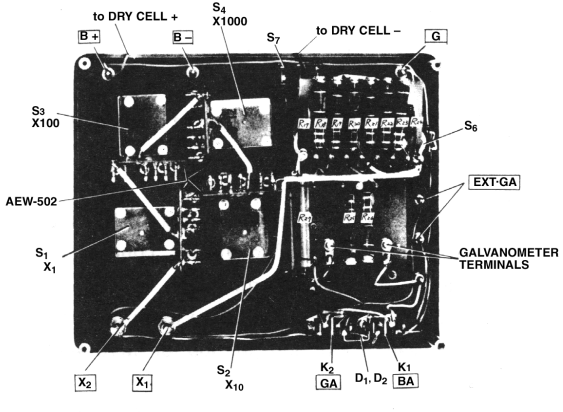

Fig.6.1 Component Location Diagram

PART LIST

R1	**Resistor, Manganin wire wounded**	1Ω
R2	〃	2Ω
R3	〃	〃
R4	〃	5Ω
R5	〃	10Ω
R6	〃	20Ω
R7	〃	〃
R8	〃	50Ω
R9	〃	100Ω
R10	〃	200Ω
R11	〃	〃
R12	〃	500Ω
R13	〃	1000Ω
R14	〃	2000Ω
R15	〃	〃
R16	〃	5000Ω
R17	〃	0.999Ω
R18	〃	8.902Ω
R19	〃	81.009Ω
R20	〃	409.09Ω
R21	〃	409.09Ω
R22	〃	81.009Ω
R23	〃	8.902Ω
R24	〃	0.999Ω
R25	〃	111.1Ω
R26	〃	10.1Ω
R27	Resistor, Carbon film	RD1/4PY 330ΩJ
R28	〃	RD2PY 10ΩJ
R29	〃	RD2PY 510ΩJ
R30	〃	RD2PY 510ΩJ
D1	Diode, Silicon	10D4 or equivalent
D2	〃	〃
GA	Galvanometer, Moving coil type	B9350DM
K1	Switch, Push button	A9150YB
K2	〃	〃
S1	Switch, Rotary	B9350BP
S2	〃	〃
S3	〃	B9350BP
S4	〃	〃
S5	〃	A9285SR
S6	Switch, Toggle	A9042SS
S7	Switch, Toggle	〃
BA	Dry cell (three)	Type SUM-1
	Circuit Board	B9350DQ

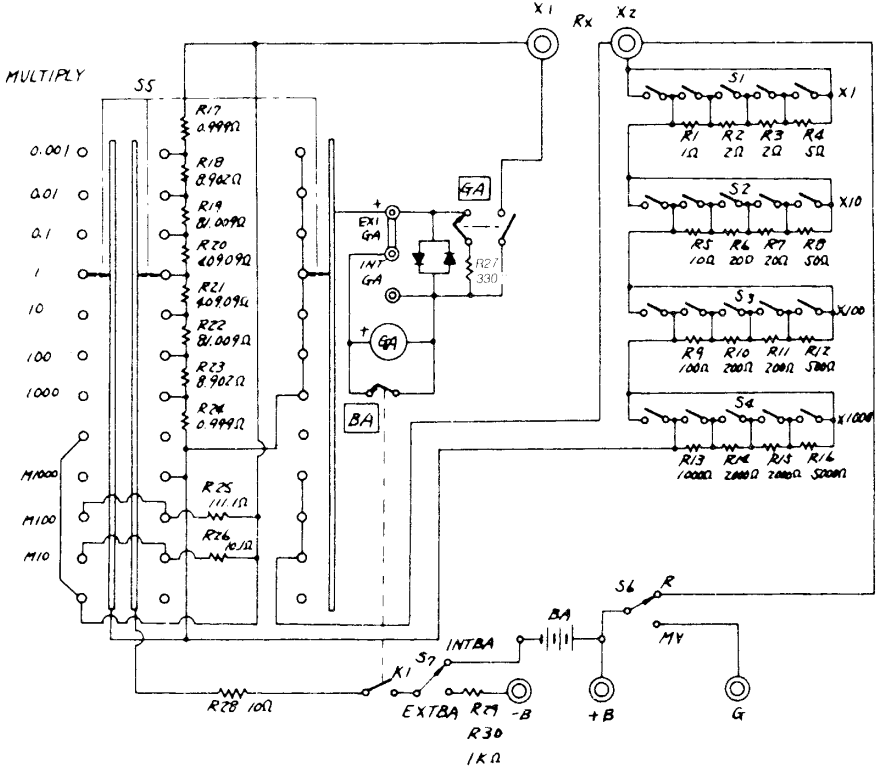

Fig.6.2 Circuit Diagram

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